Small Business Innovation Research/Small Business Tech Transfer

Liquid Sorption Pump, Phase I

Completed Technology Project (2018 - 2019)

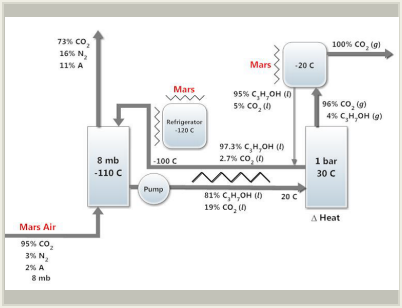
Project Introduction

The Liquid Sorption Pump (LSP) is a new technology for acquiring CO_2 from the Martian atmosphere for use in In Situ Resource Utilization (ISRU) systems. In the LSP, propanol is cooled to temperatures below -100 C, where it becomes an effective solvent for Mars atmospheric CO_2. After absorbing 5 percent or more by mole CO_2, the propanol is pumped to another vessel where it is heated to 30 C, releasing the CO_2 at pressures of more than 1 bar. The clean warm propanol is then sent back to the absorption vessel, exchanging heat with the cold absorption column effluent as it goes. After the clean propanol is cooled to near the design absorption temperature in this way, a mechanical refrigerator is used to achieve the final temperature reduction. Advantages of the LSP are that it can operate continuously day or night without the need for mechanical vacuum roughing pumps, solid freezers, or large sorption beds, requires less power than other options, is readily scalable to high outputs, and that it stops all sulfur, dust, or non-condensable gases from reaching the ISRU reactor system. In the proposed SBIR Phase 1, an operating LSP will be demonstrated and its performance assessed.

Anticipated Benefits

The primary initial application of the LSP is to provide a reliable, low cost, low mass technology to acquire CO2 on the surface of Mars out of the local atmosphere at low power. Such a system can be used to enable human exploration of Mars, as well as a Mars Sample Return mission. The LSP is dramatically superior to current alternative methods of collecting Mars CO2 because its power requirement is much less. The LSP could also be used by NASA to reduce its own CO2 emissions.

The LSP could be used to separate CO2 from flue gas. The US coal-fired electric power industry is in trouble because its CO2 emissions exceed government guidelines. The LSP can solve this by providing an economical method of collecting pure CO2 from flue gas. Once separated the CO2 could be used to enable enhanced oil recovery, expanding US oil production while combatting climate change.



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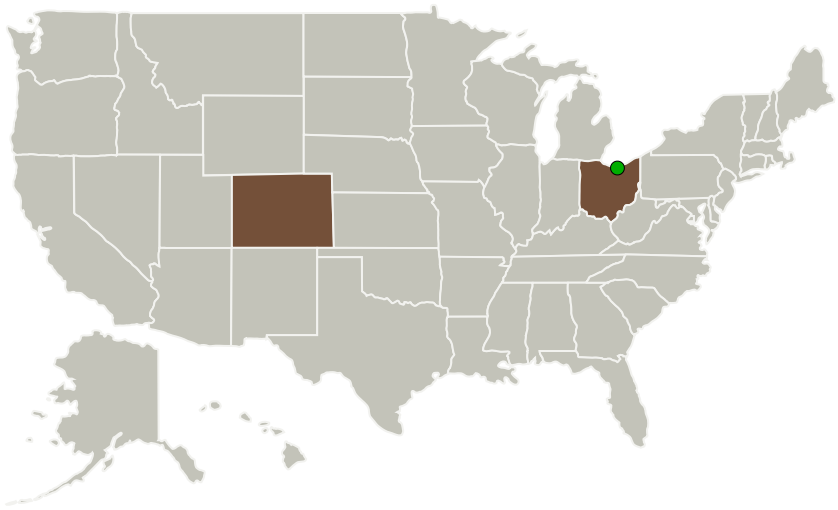
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Pioneer Astronautics	Lead Organization	Industry Historically Underutilized Business Zones (HUBZones)	Lakewood, Colorado
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Colorado	Ohio

Project Transitions

July 2018: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Pioneer Astronautics

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Robert M Zubrin

Co-Investigator:

Robert Zubrin

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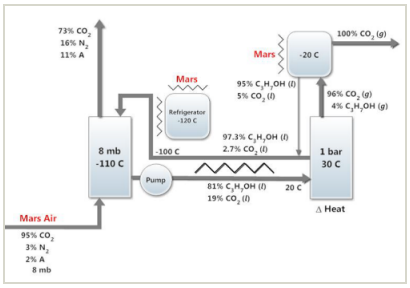
February 2019: Closed out

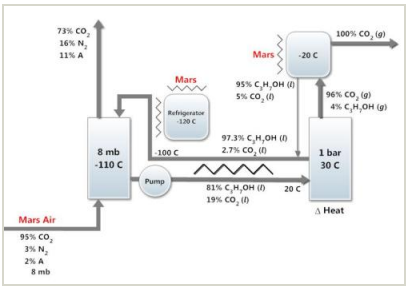
Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/141151)*

Images



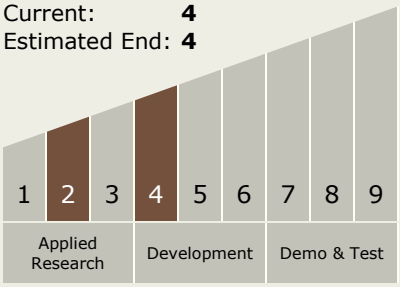
Briefing Chart Image
Liquid Sorption Pump, Phase I
(https://techport.nasa.gov/image/135968)



Final Summary Chart Image
Liquid Sorption Pump, Phase I
(https://techport.nasa.gov/image/131902)

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.1 In-Situ Resource Utilization
    - TX07.1.2 Resource Acquisition, Isolation, and Preparation

Target Destination

Mars